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Content, Conflict, Control: Semantics and Subversion

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Abstract. Collaboration requires that information can be shared, transformed and reconciled across differing representations. Communication needs structure and control, but needs also to stimulate creativity and diversity. This continual tension was pointed out by Bakhtin. Formal representation systems face the same issue, being continually subverted as differing ontologies are brought into contact, and often conflict. Examples relating to construction, learning and graphical communication illustrate the generality of these issues. Potential ways are emerging to address, and even to derive benefits from, the clash of ontologies.

Keywords: communication, collaboration, ontologies, learning, structure mapping.

1 Communication and subversion

Increasingly we face the need to collaborate around resources. This seems to be an inevitable focus in many different contexts. In learning, students need to be offered, and to share, discuss and transform, a wide range of resources of many different types. In the workplace — for instance, the construction industry — information is collected in many places, in many forms, and people need to access, discuss, abstract and augment this information in a huge variety of ways. Often the “semantic web” raises issues concerned with seeking unknown resources; but often, also, it can be about finding and supporting diverse ways to work with resources about which much is already known.

The focus in these sorts of cases falls on communication, and on how it can be structured. There are competing objectives, in many instances, even where there may not appear to be at first sight. In particular, one objective may be to facilitate the effective use of the resources, to automate various ancillary functionalities, and hence to control the structure and content of communication; whereas another objective may be to enhance creativity, foster emergent viewpoints, and encourage diversity of interpretation. The latter kinds of objectives are especially likely in areas such as design and learning, of course; but wherever they arise, they are in tension with the former kinds.

We see this kind of tension, for example, on the building site. In the construction industry, as discussed elsewhere [7], there is a natural inclination to suppose that

overarching standardisation and automation will be helpful in improving the efficiency and accuracy of communication, and in enforcing compliance with various standards, codes, regulations and legislation. However, these goals are subverted by the fact that in detail all building sites are different, and by the relentless tendency of groups to evolve their own conventions for interpretation, usage and practice. Moreover this subversion is commonly in fact desirable because it helps to accommodate local difficulties that are unforeseen by, and perhaps incommensurable with, the formal schemata of the documentation. Subversion is ultimately necessary to allow creative responses, innovation and development at both local levels and more generally. It is crucial for designers, whose stock in trade is to challenge and extend accepted notions of the limitations and even definitions of common concepts [12].

The importance of subversion is often overlooked in contexts such as construction. There is a tendency to assume that things can be defined, and once defined fixed, and that order and regularity can be imposed. The illusory nature of such assumptions is of course well recognised in many other contexts and traditions. Bakhtin is famous for having celebrated the notion of "Carnival" as an emblem of that which cannot be regulated in interaction. This might be envisaged as an occasional outbreak of mayhem, but he sought to distinguish it from transient spectacle. Rather he alludes to an ongoing process of subversion in which "a juxtaposition of marginalised and official discourses" [15] is central — a process that from his point of view is part and parcel of the notion of all human communication as "heteroglossia": a polyphony of voices vying to establish temporary dominance, or perhaps even consensus, but destined inevitably to continued dialectical struggle. And this struggle, as we have observed, guarantees that the door is always slightly ajar to innovation and creativity. The price of too much order is sterility: examples are legion. If we reflect, we know that periodic revolution establishing fresh standards and then a renewed period of sterility is also ultimately less fruitful, albeit perhaps temporarily more peaceful and less confusing, than a broad consensus that is nonetheless incessantly transformed by continual carnival underneath.

The point of this in the current context is that the representation of the structure of a domain, of communicational content — of meaning — is not something that can be fixed. It needs to be susceptible of continual negotiation. Where we define formal systems that support these representations, we need also to define systems and processes that can support their renegotiation.

2 Representation and mismatch

It's therefore possible to suggest [7] that an important role for the formal characterisation of communication is in identifying areas where there is mismatch in understandings, tension and conflict, and in pinning down the nature of the disagreement. Similarly to systems that try to enforce standardisation, the formal framework may be based on a defined ontology for the domain; but now it is seen as a temporary and local snapshot of a conceptualisation that needs to be reconciled with others, offering terms in which concepts can be seen to differ while their relationships

can also be captured. It affords, moreover, a hook on which to hang an account of reasoning and argumentation that arises around resolving the issue.

An idea rather like this has been studied in the context of the semantic web by McNeill et al. [8]. Their idea is that agents who come into dialogue about some specific issue — say, a flight booking — will commonly find that their definitions of some key terms in the interaction will differ slightly. In other words, they will have slightly different ontologies underlying their representations of the domain in question. A formal characterisation of the ontology is provided, in which the characterisation of types of component entities and relations (the *signature*) is distinguished from the basic information about instances of these in a given situation, and rules describing possible actions (the *theory*). Situations are considered in which interacting agents are developing a plan, e.g. of the actions required to book tickets, and at some point a failure is encountered. The reason for the failure can be interactively identified by the agents as some specific mismatch between their ontologies, in either signature or theory. A procedure can then be defined that will refine one of them in order to remove the problem. It's noted that this procedure in general is restricted to dealing with situations where the ontologies are on the whole quite similar and the discrepancies therefore minor. In many more complex (and perhaps realistic) cases it will be difficult to provide algorithmic approaches to resolution. Bundy and McNeill [1] propose that developing more flexible ways to resolve such issues by changing an ontology's underlying syntax and semantics is one of the grand challenges facing research in artificial intelligence: "Understanding and implementing this ability must be a major focus of AI for the next 50 years." (87) But in the meantime, even if the resolution can't be automated and has to be pursued by human agents, the identification of the point of conflict, and assisting the recording of the rationale for whatever resolution is achieved along with the nature of that resolution, may be highly valuable.

The notion of capturing "design rationale" for various purposes is well established in the design research literature, and sometimes practice. Commonly this has been related to argumentation systems, which also often produce an emphasis on dialectical processes intended to expose and resolve disagreements [3, 2]. Usually the focus is on capturing the reasons for particular design decisions. It's therefore a very general notion that can emerge differently in a variety of contexts. Here we simply note that grounding rationale, where appropriate, in a framework of ontological representation and change may be an effective way to develop its use. In practice, capturing rationale has often been found difficult, to some extent because of problems with creating a clear representation of the context, the starting point of the decision issue, and then relating the rationale clearly to this. If we anchor the rationale within the kind of process that McNeill et al. [8] suggest, then it may have a much clearer and more effective starting point.

Most of the discussion around these ontology-matching processes naturally enough arises in contexts where ontologies already exist in a more or less explicit form. In other situations, however, there may be none, or there may be only a rudimentary ontology, or one in the process of forming, and these processes may have a role in developing the ontology more fully. Such situations arise especially where ontologies are "crowd-sourced" or based on "folksonomies". Here there is often some kind of resource for which metadata is required and has to be built up or added to gradually

through an activity, perhaps of an online community. For instance, Microsoft offer “Windows Azure”, intended to assist Open Government by supporting access to data with a system called “DataMarket”:

as [citizens or developers] combine different concepts, they are actually recommending new relationships within the data ecosystem. Every interaction actually helps crowd-source changes to the ontology, which in turn makes every future interaction more powerful and relevant. [10]

This can work, up to a point, but only in so far as the people combining the concepts somehow recognise and agree on what the concepts are. Sooner or later, there will be discrepancies, and then some matching process will be needed that can actually reconcile the existing ontology with proposed changes. On the face of it, systems like this are likely to support a monotonic process of accretion around an ontology that in itself is retained; and therefore additions that are in some sense inconsistent with the existing material are likely to be rejected. In general terms, something more flexible is needed, that can potentially accommodate in both directions.

3 An example: learning

Another example of a case like this is where we have data, such as video, that has rich content but little explicit representation of it. We are starting to develop automated means of analysing these kinds of data, but there is a long way to go. In the interim, it makes sense to involve communities of users in creating and improving metadata. A pilot project in Edinburgh has been developing a system for learners, in which learning materials are offered in the form of rich media that can be manipulated and annotated. Known as “YouTute”, the approach is based on videos of tutorial discussions that occur in ordinary tutorial groups, where typically 5-10 students will discuss a series of problems with a tutor. We collect naturally occurring tutorial dialogues as unedited video. Three streams are collected per tutorial (two from cameras, one from a “Smartboard” that captures anything written on it during the activity). These are later played in synchrony via a web-based interface that allows students to review the material and “edit” it by identifying segments that are of interest. These segments (which we call “tutes”) can be named, tagged, annotated and shared with other students. Students are able to see texts of relevant lecture slides, and the questions being discussed in the tutorial. The system has been deployed on several courses, is well received by students and seems to have worked especially well as a revision aid [11, 6]. A screenshot of the system in use appears in Figure 1.

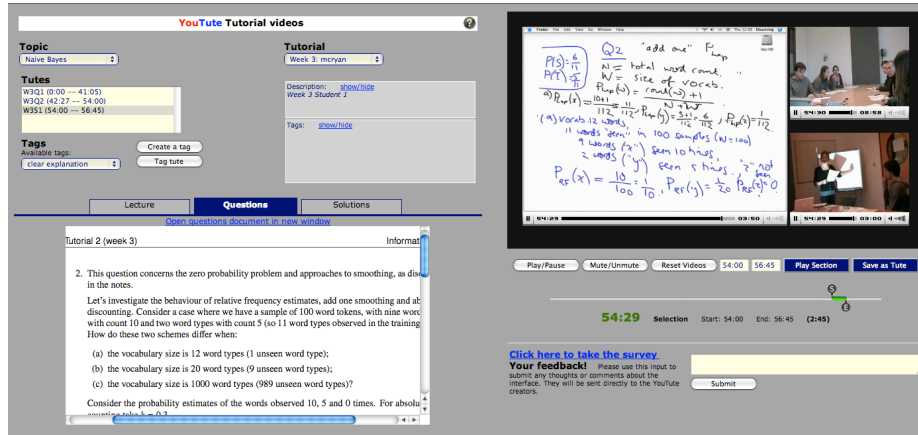


Figure 1. YouTube interface

The process of editing the videos and selecting “good” dialogues is a shared activity, the responsibility of the students. It is a form of “social networking”, through which a community of students can emerge as learners who collaborate to create a new learning resource. This shared activity is also itself a learning activity, promoting reflection on the topics discussed, and re-evaluation of the original tutorial discussion.

In the present context, the significance of this approach is that the learners will in the long run have to develop their own ideas about what constitutes interesting learning material, how it is organised, what are its constituent parts, how its various categories relate. Which is to say that they will have to evolve an ontology of learning materials, related probably also to the domain about which they are learning (in our cases so far, theoretical aspects of computer science). At present, all of this is implicit: the learners use only unstructured tags and free text, but in further development of the system a clearer ontology would certainly be required and desired, to facilitate organisation, search and use of the information. This ontology needs to be negotiated, and continually negotiable, as new learners enter the community, new topics are addressed, new ways of organising the material devised. However, there is a further wrinkle: we intend also that learners would be able to link other materials into the resource being constructed, e.g. other lectures found on the internet, pieces of video from broadcasters’ archive sites, documents and notes from a variety of sources. Whatever these things are, their content will need to be related to the existing material, but they will come with their own metadata, based on a variety of other ontologies. Once again we face the ontology matching problem.

Again the message is that no amount of standardisation, e.g. exploitation of Dublin core or other schemata, will overcome this problem. But in fact it should not be seen as a problem — rather, it is an opportunity, to address the challenge and devise good approaches that will offer real flexibility combined with powerful support.

4 An example: graphical communication

In some respects, this discussion about ontologies can be seen as similar to certain aspects of reasoning by analogy, or using modalities such as graphics in reasoning. In analogical reasoning, one has to develop a mapping between structures, e.g. the “structure-mapping” approach of Gentner [5, 4]. There is a domain to be reasoned about, for instance the structure of atoms, and one finds a domain with relatable structure, e.g. the solar system, and uses the latter to reason about the former. Where there is analogy, of course, there is also disanalogy: one has to select specific elements of the two domains that will be related, disregarding others completely, and generally allowing that there will be some looseness of fit even between those that are used. Similarly in reasoning with graphics: Wang, with colleagues including the present author [13, 14], discussed some time ago a system at least superficially related at a formal level to the technique adopted by McNeill et al. [9], in which domains are represented algebraically as a signature of types of element, accompanied by a more specific theory. One domain, of course, is the graphical domain, in which objects such as perhaps lines and circles can be represented as being in various geometrical relationships. The other is whatever domain is to be depicted: once this is represented in a similar manner, a “signature morphism” (i.e. a structure mapping) can be defined that shows how various elements are depicted and e.g. what operations on the depiction are meaningful. Thus, for instance, one can give a clear semantic account of how Euler circle diagrams can be used to reason about the relationships between sets in general, or specific sets of particular things; or of how a certain sort of diagram can be used to depict both the atom and the solar system.

It would certainly be desirable for collaborative work to be supported by these kinds of representations. Collaborators will naturally want to introduce new entities into the activity, and manipulate the ones that are already there. In this context, accommodating something as yet undepicted into a given representation (system) is like the process of accommodating it to a given ontology. In one sense, the ontologies of the graphical system and the depicted domain are very different, but under the morphism they are very close, if not identical. However, in the practical use of this kind of representation system, as in any other, there will always be change: changing contexts, purposes, user communities, etc. We want the mapping to subserve a purpose — the support of some argument or line of reasoning — and it may well happen, perhaps it will inevitably happen, that to subserve we must subvert, in the sense of changing the mapping to adjust its fit to differing and developing understandings of the domain and/or the reasoning process.

5 Conclusion

The point of these reflections has been to emphasise that the issues of flexibility and accommodation in formal systems are extremely general. Wherever communication happens, we need to support appropriate models of use. If Bakhtin, among many others, has alerted us to the ubiquitous nature of subversion, the ceaselessly carnivalesque nature of communication, we have also seen how this emerges in a

variety of apparently quite formalised frameworks. It is not yet at all clear how in general to approach resolutions, but we have noted that there are moves and pointers in encouraging directions. In general we concur with Bundy and McNeill [1] in identifying this as a key issue for further research.

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